AD-A037 944 IBM FEDERAL SYSTEMS DIV OWEGO N Y F/G 5/9
PROGRAM DOCUMENTATION FOR THE T4 EWO CREW STATION SIMULATION PR--ETC(U)
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PROGRAM DOCUMENTATION FOR THE T4 EWO CREW STATION SIMULATION PROGRAMS

INTERNATIONAL BUSINESS MACHINES CORPORATION
FEDERAL SYSTEMS DIVISION
OWEGO, NEW YORK 13827

FEBRUARY 1977

Approved for public release; distribution unlimited

AEROSPACE MEDICAL RESEARCH LABORATORY
AEROSPACE MEDICAL DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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AMRL-TR-77-6

This report has been reviewed by the Information Office (OI) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

CHARLES BATES, JR.
Chief
Human Engineering Division
Aerospace Medical Research Laboratory

AIR FORCE - 23 MARCH 77 - 100

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AMRL-TR-77-6	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) 6 PROGRAM DOCUMENTATION FOR THE T4 EWO CREW STATION SIMULATION PROGRAMS.		5. TYPE OF REPORT & PERIOD COVERED Program Documentation
		6. PERFORMING ORG. REPORT NUMBER AMRL HESS REPORT 77-2
7. AUTHOR(s) 10 W. E. Brandt, Jr		8. CONTRACT OR GRANT NUMBER(s) 15 F33615-75-C-5152
9. PERFORMING ORGANIZATION NAME AND ADDRESS Federal Systems Division International Business Machines Corporation Owego, New York 13827		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62202F, 16 7184-14-05 17 14
11. CONTROLLING OFFICE NAME AND ADDRESS Aerospace Medical Research Laboratory Aerospace Medical Division, Air Force Systems Command, Wright-Patterson AFB, Ohio 45433		12. REPORT DATE 11 February 1977
		13. NUMBER OF PAGES 70
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) 18 AMRL, AMRL 19 TR-77-6, HESS-77-2		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

12 70p.

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

9 Technical rept.,

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The ALQ-T4 EWO Crew Station Simulation Programs were written for the Crew Station Integration Branch (HED), Human Engineering Division, Aerospace Medical Research Laboratory. The overall function of the entire system of programs is to provide the capability for studying the performance of a trained Electronic Warfare Officer (EWO) during an electronic warfare simulation, to support studies to analyze the impact of the addition of new equipment, and the organization of old equipment on crew performance.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

409 206

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A real-time program controls and monitors an AN/ALQ-T4 B-52 EW Crew Station Simulator that has been modified to include a set of equipment changes associated with the Advanced Phase VI B-52 EW Crew Station Project. The subject response times, at which all input transitions occur, and the times that the emitters stations are turned on/off are recorded for subsequent analysis.

This system was written for an IBM System/370, Model 155 Computer. OS Assembler Language and FORTRAN IV were used in coding the subroutines. An IBM 1827 Data Control Unit is used as an interface between the 370 Computer, SPC-16 Computer, and threat emitter stations.

PREFACE

This program was developed for the Human Engineering Division, Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio 45433. The work was performed by International Business Machines Corporation, Owego, New York 13827, under Contract Number F33615-75-C-5152. Stephen D. Kay of the Systems Research Branch was the contract monitor for the Aerospace Medical Research Laboratory. The work was performed in support of "Project 7184," "Human Engineering for Air Force Systems," Task 718414, "Systems Research for Advanced Design."

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SECTION I

INTRODUCTION

The T4 EWO Crew Station Simulation Programs were developed at the Human Engineering Systems Simulation (HESS) facility for the purpose of aiding the Crew Station Integration Branch of AMRL in studying the performance of a trained B-52 Electronic Warfare Officer (EWO) during an electronic warfare simulation. The T4 EWO Crew Station Programs control and monitor an AN/ALQ-T4 (T-4) electronic warfare simulator to collect and record output data from a simulated mission.

Section II of this document summarizes the machine configuration required for the T4 EWO Crew Station Programs. The experiment description is summarized in Section III and the program descriptions are presented in Section IV. The input and output record formats are discussed in Section V and the program card decks are discussed in Section VI. Section VII contains the program logic diagram and program flowcharts. Operator instructions for the computer operator are contained in Appendix I. Two types of error recovery instructions are contained in Appendix II. All console typewriter messages and an explanation of each are contained in Appendix III. A Program description, flow chart, and a set of user instructions for the SPC-16 Download Program are contained in Appendix IV.

SECTION II

MACHINE DEFINITION

The T4 EWO Experiment program was written for an IBM System/370 Computer operating under the standard MFT version of the Operating System. The hardware components used by this program are listed below:

- o IBM System/370 Computer, Model 155
- o Problem Program Core Requirements - 200K
- o IBM 1403 Printer
- o IBM 2501 Card Reader
- o IBM 3215 Console Printer-Keyboard
- o IBM 1827 Data Control Unit (with digital input/output features)
- o ITEL 7830 Storage Control Unit with three 7330 Disk Storage Units

The hardware configuration which supports the T4 EWO experiment is interfaced to the System/370 via the 1827 Data Control Unit. The System/370 controls and monitors an AN/ALQ-T4 electronic warfare crew station simulator. The simulator is designed to present a realistic model of the task situations encountered by an Electronic Warfare Officer (EWO) in a B-52 aircraft. It is used primarily to train and evaluate Electronic Warfare Officers on a continuing basis.

The student station is a model of the actual EWO station on board a B-52. The controls and displays presented to the subject are identical to those in the aircraft.

SECTION III

EXPERIMENT DESCRIPTION

A trained Electronic Warfare Officer is seated in the student station of the T-4 trainer. Initially he performs all of the tasks necessary to check-out the system prior to starting the experiment. The EWO then participates in a simulated mission, during which threats are presented to him. He is required to take proper action. The time at which threats occur is controlled by the program through the digital-output features of the 1827 Data Control Unit. The subject's responses are recognized through the digital and pulse repetition interval inputs (PRI), and relevant data is stored on disk for subsequent analysis by a data reduction program.

SECTION IV

PROGRAM DESCRIPTION

The T4 EWO Experiment Program was written for an IBM System/370, Model 155 Computer running under the standard MFT version of the Operating System. It includes two assembler language subroutines, two Fortran subroutines, and four utility type programs. Table 1 lists the names of all the user-written subroutines and utility programs by name and function(s), and lists the names of the subroutines which call each one.

Following are two techniques used in the program which might not be immediately obvious to the user:

1. Intercommunication among the subroutines is done through a large COMMON CSECT.

2. The analog data described in this document is not acquired by means of an analog to digital converter, but is pulse repetition interval (PRI) data acquired from the CRT display of the ALR-20A receiver system. This PRI data is transfered to the 370 Computer from the SPC-16 Computer via the 1827 Data Control Unit (DCU) and a special interface. This is accomplished as a block transfer of 328 16 bit words. This data is stored internal to the T4REAL Program in the "328 Word Analog Input Buffer."

4.1 T4REAL

The T4REAL Program is the real-time control program for the T4 experiments. Its primary functions are to control the on/off status of the threat stations and to collect and record all the pertinent data from experiments.

During the initialization part of the program, the scenario input cards are decoded and an internal scenario table is constructed. This table is used to control the threat stations throughout the experiment. When one of the scenario entries dictates that a station is to be turned on, the appropriate digital output bit is set to one and transmitted to that particular station. Likewise, when it is turned off, the appropriate bit is set to zero. A recording is made each time one of these scenario entries is used.

Subroutine Name	Functions	Called By
T4REAL	Turns the threat stations on and off. Collects and records all the digital and analog changes which occur during the experiments	NONE
T4COPY	Generates two backup copies of the output data from each experiment	NONE
T4FRMT	Extracts that portion of the EWO output data needed for analysis purposes. This data is reformatted to conform to the input data requirements of the analysis program	NONE
T4SERCH	Retrieves a set of data from the EWO backup file, and prepares it for use by other analysis programs	NONE
T4SIMOUT	Generates a printout, in chronological order, of all EWO actions and the time each action occurred during simulations	NONE
READER	Reads input data files. Constructs storage tables and initializes variables	T4REAL
CONVT	Performs double precision arithmetic with Sums and Sum squared data	T4REAL
SIGMA	Computes the Mean, Standard Deviation, Sum and Sum squared	T4REAL

TABLE 1 PROGRAM FUNCTION TABLE

As the input data sets are being read, the scenario input data, the threshold data and the control card data are listed on the printer. After all general initialization procedures are completed a message is printed on the console typewriter 'WAITING FOR MISSION START' and the program enters a two instruction loop and remains in this loop until the T4 simulator monitor toggles the RUN/FREEZE Switch from "FREEZE" position to "RUN" position. From then until the end of the experiment the program cycles through a timer controlled loop, the duration of which is controlled via a program constant "SETIME."

As the program constantly cycles throughout the experiment continually examining the scenario times to determine if a new digital output signal is to be transmitted four other functions are being monitored.

These include: 1) logic which checks for and warns the operator of excessive noise on analog and digital input signals, 2) logic which detects and records normal switch transitions represented by bit changes on digital input signals, 3) logic which detects and records a hands-on or hands-off condition represented by PRI data fluctuations which correspond to ALR-20A frequency fluctuations, 4) logic which checks for and warns the operator of excessive output of data records.

It should be mentioned that raw data counts are calibrated from a 0-5000 value in units of time in microseconds, which represents a full left to right sweep of the ALR-20A CRT.

Noise counters are maintained for each group of analog and digital input. Each threshold crossing by a raw data count causes the noise counter for that particular analog group to be incremented by one. Similarly, each change in a digital input group causes the noise counter for that group to be incremented. The counting continues for a specified number of loops, referred to as a time window, and then all noise counters are examined to see if any counts exceed the specified alarm value. Those channels or groups that have excessive noise counts are immediately printed with appropriate text to indicate that corrective action must be taken. The alarm printout also indicates the relative time during the experiment when this difficulty was encountered. Similarly, a data output record count, along with the relative time is printed each time the data record counter exceeds a specified data lines counter.

The size of the time window to be employed is expressed via a control card input. Control card inputs are also provided for specifying the alarm values for both raw data counts, digital inputs, and the data lines counter. After the noise inspection is completed, the noise window counter and all counters are reset to zero for another cycle of noise and excessive data output detection.

Digital input changes are detected by comparing each 16-bit group value in the alternate buffer with the corresponding group in the

digital input save area. If any of the 16 bits do not agree, the entire group in the save area is replaced with the new group from the alternate buffer and the change is recorded. The recording is made by adding another entry to the output data buffer containing the current time value, the group number and the group contents.

There are two types of raw data counts received from the T-4 trainer. The first type is caused by a jammer control knob manipulation by the EWO. The second type occurs as a result of a threat frequency which can be detected after a threat station is turned on via a digital output signal. Both types are treated the same for recording purposes and are labeled hands-on ("HNAL") or hands-off ("HFAL").

Two program controlled constants, CCALON and CCALOF, are used by the program to minimize the amount of redundant data records that would be written as a result of sporadic threshold crossings caused by noise. The "hands-on" detection constant, CCALON, contains the number of program loops during which the signal must stay outside a predefined threshold band before it is recognized as a hands-on condition. For example, if CCALON is set to a 12, the program would recognize a raw data count change as a knob manipulation if the raw data count exceeded the threshold band for 12 consecutive program loops. A set of data defining the detection would then be recorded in the output data buffer.

If the incoming raw data count remains inside this new threshold band for a number of program loops equal to the other program controlled constant, CCALOF, it is considered a "hands-off" condition. That is, the EWO has removed his hand from the knob or the threat frequency has leveled off. This situation is also recorded in the output data buffer.

Sporadic threshold crossings due to noise cannot cause a change from "hands-off" to "hands-on" because they will not consistently exceed threshold for the required number of consecutive loops. However, all threshold crossings contribute to the noise count that is accumulated during each noise count window.

In order to obtain an accurate measurement of the voltage represented by a hands-off condition, up to 100 samples of that specific analog signal are accumulated following the hands-off detection. A fewer number of samples may be used if a hands-on condition occurs prior to obtaining the 100 samples. In either case, the raw data counts are averaged and recorded as a mean and standard deviation along with the analog group indicator and the time at which the hands-off detection occurred.

A software clock is maintained during the simulation and is the basic reference for all timing measurements. This software clock is updated at the beginning of each program loop by adding an increment of time

to its previous value. The increment of time is based on times read from the hardware timer for this loop and the previous loop. Initially the software clock is set to zero. Therefore all time values recorded are relative to the start of the experiment. In addition, a pseudo timer, internal to the T4REAL program is used to control the program cycle time.

Data recordings made during the experiment are held in an output buffer that is 129,600 bytes in length and should be large enough to contain all the output data recorded during an experiment. However, after every 12 bytes of data is stored in the output data buffer, the buffer pointer is incremented and tested to see if the buffer is full. In the event that it is, the program will write the first 7200 bytes of the OUTDATA buffer onto disk. After the write is completed the output buffer pointer is initialized to the beginning of the output buffer, and the first 7200 bytes of the output buffer are made available. Each time another 7200 bytes are filled, another 7200 byte section is written. This sliding buffer technique continues until the end of the experiment. The program is terminated when the experiment control switch is turned from "RUN" position to "FREEZE" position.

4.2 T4COPY

The T4COPY utility program was written to provide two backup copies of the output data from each experiment. One copy is transferred to disk and the other one to tape. Each one contains the experiment ID numbers, and the real-time output from the experiment. The real-time output contains records of all raw data counts and switch transitions that occurred during the experiment.

4.3 T4FRMT

The T4FRMT utility program was written to extract that portion of the simulation output data needed for analysis purposes. This data is formatted and sorted to conform to the input data requirements of the analysis program. An optional input feature permits the user to retrieve and format the data from the most recent experiment, or to selectively retrieve data stored by the T4COPY program from an earlier experiment.

The data is reformatted by converting each bit of each group of digital input to a binary number representing an index to a digital input status table in the analysis program. Group one, bit one is converted to an index of one. Group one, bit two is converted to an index of two, etc. The digital output groups and the analog input groups are converted in basically the same manner. The FORTRAN analysis program can simply use these converted values to index directly into status arrays for the three types of input.

After all of the data is reformatted, the Sort Utility Program calls the IBM S/370 Sort/Merge Program for sorting the data into chronological sequence.

4.4 T4SERCH

The T4SERCH Utility Program was written to provide a convenient means for retrieving a set of data from one of the backup files, and prepare it for use by other analysis programs. This eliminates the need to write a search capability for every analysis program written for the system. The user, via a control card, specifies the ID number of the experiment to be analyzed. The search routine transfers the real-time output data to temporary data sets for easy access.

4.5 T4SIMOUT

The T4SIMOUT Program provides the experimenter with a "quick look" overview of the T4REAL output data. It generates a chronological printout of all the digital and analog data changes which occurred during the experiment. The subroutine, CONVERT, is used to convert digital bit patterns to zoned format for output purposes.

SECTION V

INPUT/OUTPUT FORMATS

This section describes the input and output formats used by the T4 EWO Simulation Programs. The format of the parameter control card is shown in Figure 1. Figure 2 illustrates the format of the threshold data cards containing threshold information used by the T4REAL Program. Figure 3 illustrates the format of the scenario data cards used in the T4REAL Program to control the on/off status of the threat emitter stations.

There is one output data set created by the T4REAL Program. Its format is shown in Figure 4. This data set is used directly as input to the T4COPY, T4FRMT, and T4SIMOUT Programs.

There is one output data set created by the T4COPY Program. Its format is shown in Figure 5. This data set is used directly as input to the T4FRMT Program. Figure 6 illustrates the output format of the T4FRMT Program.

Figure 7 illustrates the format of the input control card used by the T4FRMT Program. The format of the control card used by the T4SERCH Program is illustrated in Figure 8.

Tables 2 and 3 define the address assignments used for digital input, and digital output respectively.

At the end of an experiment, a printout is generated by the T4SIMOUT Program. It contains a chronological list of all the EWO actions and the time each action occurred during an experiment. A sample of the printout is illustrated in Figure 9.

RECORD NO.	RECORD POSITION	CONTENTS	FORTRAN FORMAT	UNITS
ICODE	1-2	'CT' TYPE IDENTIFIER	A2	-
PRTFLG	4	TYPE RUN PRETEST = 1 MISSION = 0	L1	-
ISTHR	6-7	START CLOCK TIME = HOURS	I2	-
ISTMIN	9-10	START CLOCK TIME = MINUTES	I2	-
ISTSEC	12-13	START CLOCK TIME = SECONDS	I2	-
CCALON	15-18	HANDS-ON SETTING. THIS PARAMETER SPECIFIES THE NUMBER OF CONSEC-UTIVE LOOPS DIGN TIMES MUST EXCEED THRESHOLD TO ESTABLISH A HANDS-ON DETECTION	I4	-
CCALCF	20-23	HANDS-OFF SETTING	I4	-
CLPCNT	25-28	CLPCNT LOOP COUNT	I4	-
CONOSE	30-33	DIGITAL INPUT NOISE ALARM SETTING	I4	-
CANOSE	35-38	DI /SA INPUT NOISE ALARM SETTING.	I4	-
CDATAL	40-43	DATA LINES TRIGGER	I4	-

RECORD FORMAT = FIXED LENGTH
RECORD LENGTH = 80 BYTES
MEDIUM USED = PUNCHED CARDS

NOTE. ALL ENTRIES RIGHT JUSTIFIED IN COL. SPECIFIED WITH LEADING ZEROES.

FIGURE 1. CONTROL CARD FORMAT

RECORD NO.	RECORD POSITION	CONTENTS	FORTRAN FORMAT	UNITS

THE NEXT SET OF RECORDS DEFINE JAMMER THRESHOLD INFORMATION. ONE RECORD PER JAMMER. (MINIMUM NO. OF RECORDS = 26, MAXIMUM = 26)

RECORD NO.	RECORD POSITION	CONTENTS	FORTRAN FORMAT	UNITS
	1-2	'JA' TYPE IDENTIFIER	A2	-
	4-5	JAMMER CARD NUMBER 01-26	I2	-
1	7-10	THRESHOLD SETTING T0	I4	1 MICRO.
	12-15	THRESHOLD SETTING T1	I4	1 MICRO.
	17-20	THRESHOLD SETTING T2	I4	1 MICRO.

THE NEXT SET OF RECORDS DEFINE TRACE WIDTH THRESHOLD INFORMATION, ONE RECORD PER TRACE WIDTH (MINIMUM NUMBER OF RECORDS = 7, MAXIMUM = 7)

RECORD NO.	RECORD POSITION	CONTENTS	FORTRAN FORMAT	UNITS
2	1-2	'TW' TYPE IDENTIFIER	A2	-
	1-2	'TW' TYPE IDENTIFIER	A2	-
	4-5	TRACE WIDTH CARD NUMBER 01-07	I2	-
3	7-10	THRESHOLD SETTING 1	I4	1 MICRO.
	12-15	THRESHOLD SETTING 2	I4	1 MICRO.

FIGURE 2. THRESHOLD DATA CARD FORMAT

THE NEXT RECORD CONTAINS A & B MARKER THRESHOLD INFORMATION. ONE RECORD.

4	1-2	'MA' TYPE IDENTIFIER	A2	-
	1-2	'MA' TYPE IDENTIFIER	A2	-
	4-5	UNUSED		
5	7-10	MARKER A THRESHOLD	I4	1 MICRO.
	12-15	MARKER B	I4	1 MICRO.

THE NEXT RECORD DEFINES RF THRESHOLD INFORMATION, (MINIMUM NUMBER OF RECORDS = 1, MAXIMUM = 1)

	1-2	'RF' TYPE IDENTIFIER	A2	-
	7-10	RF 1 THRESHOLD	I4	1 MICRO.
	12-15	RF 2 THRESHOLD	I4	1 MICRO.
	17 20	RF 3 THRESHOLD	I4	1 MICRO.
6	22-25	RF 4 THRESHOLD	I4	1 MICRO.
	27-30	RF 5 THRESHOLD	I4	1 MICRO.
	32-35	RF 6 THRESHOLD	I4	1 MICRO.
	37-40	RF 7 THRESHOLD	I4	1 MICRO.
	42-45	ESAS THRESHOLD	I4	1 MICRO.

FIGURE 2. THRESHOLD DATA CARD FORMAT (CONTINUED)

RECORD NO.	RECORD POSITION	CONTENTS	FORTRAN FORMAT	UNITS
THE NEXT RECORDS DEFINE THE THREAT THRESHOLD INFORMATION, ONE RECORD PER THREAT (MINIMUM = 75, MAXIMUM = 75)				
	1-2	'TR' TYPE IDENTIFIER	A2	-
	4-5	THREAT CARD NUMBER 01-75	I2	-
	7-10	THREAT THRESHOLD T0	I4	1 MICRO.
7	12-15	THREAT THRESHOLD T1	I4	1 MICRO.
	17-20	THREAT THRESHOLD T2	I4	1 MICRO.

RECORD FORMAT = FIXED LENGTH
RECORD LENGTH = 80 BYTES
MEDIUM USED = PUNCHED CARDS

NOTE. ALL ENTRIES RIGHT JUSTIFIED IN THE COLUMNS SPECIFIED WITH LEADING ZEROES

FIGURE 2. THRESHOLD DATA CARD FORMAT (CONCLUDED)

RECORD NO.	RECORD POSITION	CONTENTS	FORTRAN FORMAT	UNITS
1	1-2	'SD' TYPE IDENTIFIER	A2	-
	1-2	'SD' SCENARIO CATA IDENTIFIER	A2	-
	4-5	DIGITAL OUTPUT GROUP ADDRESS NUMBER	I2	-
	7-8	BIT POSITION TO BE SET. BIT POSIT-IONS LEFT TO RIGHT ARE 00 THRU 15	I2	-
2	10-11	HOURS	I2	-
	13-14	MINUTES	I2	-
	16-17	SECONDS	I2	-
	19	BIT SETTING - A CNE SETS BITS ON - A ZERO SETS BITS OFF	I2	-

RECORD LENGTH = 80 BYTES
RECORD FORMAT = FIXED LENGTH
MEDIUM USED = PUNCHED CARDS

NOTE. IN THE PRETEST SCENARIO EVERY 'ON' CARD MUST BE FOLLOWED BY AN 'OFF' CARD.

FIGURE 3. SCENARIO INPUT FORMAT

RECORD NO.	RECORD POSITION	CONTENTS	TYPE OF DATA	NUMBER BYTES
1 TO N	1-4	VARIABLE LENGTH CONTROL WORD	----	4
	5-6	YEAR.	LITERAL	2
	7-9	DAY (JULIAN).	LITERAL	3
	10-13	TIME OF DAY IN HOURS AND MINUTES.	LITERAL	4
	14-16	BLANKS.	----	4
	17-7104	RECORDED DATA (SEE BELOW).	----	7088
EACH 12 BYTES OF THIS SECTION WILL CONTAIN ONE OF THE FOUR FORMATS ILLUSTRATED BELOW.				
DIGITAL OUTPUT DATA	1-4	IDENTIFIER. APPEARS AS ' DO'	LITERAL	4
	5-6	DO GROUP ADDRESS (ABSOLUTE).	INTEGER	2
	7-8	DIGITAL OUTPUT DATA (16BITS).	INTEGER	2
	9-12	RELATIVE TIME AFTER START OF EXPERMENT IN UNITS OF 1/100 OF A SECOND.	INTEGER	4
DIGITAL INPUT DATA	1-4	IDENTIFIER. APPEARS AS ' DI'	LITERAL	4
	5-6	DI GROUP ADDRESS (RELATIVE).	INTEGER	2

FIGURE 4. RECORD FORMAT FOR T4REAL OUTPUT & T4CCPY, T4FRMT & T4SIMOUT INPUT

RECORD NO.	RECORD POSITION	CONTENTS	TYPE OF DATA	NUMBER BYTES
DIGITAL INPUT	7-8	DIGITAL INPUT DATA (16 BITS).	INTEGER	2
DATA (CONT'D)	9-12	RELATIVE TIME AFTER START OF EXPERMENT IN UNITS OF 1/100 OF A SECOND.	INTEGER	4
'HANDS-ON'	1-4	IDENTIFIER. APPEARS AS 'HNAL'.	LITERAL	4
DATA	5-6	CHANNEL ADDRESS. 0-327	BINARY	2
	7-8	FREQUENCY IN UNITS OF MICRCSECONDS	BINARY	2
	9-12	RELATIVE TIME AFTER START OF EXPERIMENT IN UNITS OF 1/100 OF A SECOND .	BINARY	4
'HANDS-OFF' DATA	1-4	IDENTIFIER. APPEARS AS 'HFAL'.	LITERAL	4
(PART1)	5-6	CHANNEL ADDRESS. 0-327	INTEGER	2
	7-8	NUMBER OF SAMPLES. INCLUDED IN MEAN NO. OF SAMPLES. INCLUDED IN M TIME.	INTEGER	2
	9-12	RELATIVE TIME AFTER START OF EXPERIMENT IN UNITS OF 1/100 OF A SECOND.	INTEGER	4
'HANDS-OFF' DATA	1-4	IDENTIFIER. APPEARS AS 'HFA2'.	LITERAL	4
(PART2)	5-8	MEAN INPUT (TIME).	REAL	4
	9-12	STANDARD DEVIATION (TIME).	REAL	4

ALL SUBSEQUENT RECORDS WILL CONTAIN OUTPUT DATA STARTING WITH POSITION 5.

RECORD FORMAT VARIABLE BLOCKED
MEDIUM USED = DISK

MAXIMUM RECORD LENGTH = 7204
MAXIMUM BLOCK SIZE = 7208

FIGURE 4. RECORD FORMAT FOR T4REAL OUTPUT & T4CCPY, T4FRMT & T4SIMOUT INPUT (CONCLUDED)

RECORD NO.	RECORD POSITION	CONTENTS	TYPE OF DATA	NUMBER BYTES
1	1-4	VARIABLE LENGTH CONTROL WORD.	INTEGER	4
	5-6	YEAR.	LITERAL	2
	7-9	DAY (JULIAN).	LITERAL	3
	10-13	TIME OF DAY IN HOURS AND MINUTES.	LITERAL	4
	14-16	BLANKS.	LITERAL	3
3-N	SAME FORMAT AS DEFINED IN FIGURE 4.			

RECORD FORMAT = VARIABLE BLOCKED
MAXIMUM RECORD LENGTH = 7204
MAXIMUMBLOCK SIZE = 7208
MEDIUM USED = DISK

FIGURE 5. RECORD FORMAT FOR T4COPY OUTPUT & T4FRMT & T4SERCH INPUT

RECORD NO.	RECORD POSITION	CONTENTS	TYPE OF DATA	NUMBER BYTES
1	1-4	VARIABLE LENGTH CONTROL WORD.	INTEGER	4
	5-8	ZEROES.	----	4
	9-12	DATE-TIME ID NUMBER.	INTEGER	4
DIGITAL INPUT RECORDS	1-4	VARIABLE LENGTH CONTROL WORD.	INTEGER	4
	5-8	IDENTIFIER. APPEARS AS ' DI'	LITERAL	4
	9-10	DIGITAL INPUT ARRAY INDEX NUMBER.	INTEGER	2
	11-12	ON/OFF INDICATOR. 0 = OFF, 1 = ON.	INTEGER	2
	13-16	RELATIVE TIME BIT CHANGE OCCURRED. IN UNITS OF 1/100 OF A SECOND.	INTEGER	4
	17-20	SORT SEQUENCE NUMBER.	INTEGER	4
	21-28	ZEROES.	----	8

FIGURE 6. RECORD FORMAT FOR T4FRMT OUTPUT

RECORD NO.	RECORD POSITION	CONTENTS	TYPE OF DATA	NUMBER BYTES
HANDS-OFF RECORDS	1-4	VARIABLE LENGTH CONTROL WORD.	INTEGER	4
	5-8	IDENTIFIER. APPEARS AS 'HFAL'.	LITERAL	4
	9-10	ANALOG CHANNEL ARRAY INDEX NUMBER.	INTEGER	2
	11-12	NUMBER OF SAMPLES TO GET MEAN TIME.	INTEGER	2
	13-16	RELATIVE TIME HANDS-OFF OCCURRED. IN UNITS OF 1/100 OF A SECOND.	INTEGER	4
	17-20	SORT SEQUENCE NUMBER.	INTEGER	4
	21-24	MEAN TIME.	REAL	4
	25-28	STANDARD DEVIATION (TIME).	REAL	4

RECORD FORMAT = VARIABLE BLOCK
MAXIMUM RECORD LENGTH = 28
MAXIMUM BLOCK SIZE = 28
MEDIUM USED = DISK

FIGURE 6. RECORD FORMAT FOR T4FRMT OUTPUT (CONCLUDED)

RECORD NO.	RECORD POSITION	CONTENTS	FORTRAN FORMAT	UNITS
	THIS CARD HAS ONE OF THE TWO FOLLOWING FORMATS.			
1	1-2	YEAR.	XX	2
	3-5	DAY (JULIAN).	XXX	3
	6-9	TIME OF DAY IN HOURS AND MINUTES.	XXXX	4
	1-4	'DISK'.	AAAA	4

A = ALPHABETICAL CHARACTERS
X = NUMERICAL

RECORD FORMAT = FIXED LENGTH
RECORD LENGTH = 80 BYTES
MEDIUM USED = PUNCHED CARD

RECORD NO.	RECORD POSITION	CONTENTS	FORTRAN FORMAT	UNITS
1	1-2	YEAR.	XX	2
	3-5	DAY (JULIAN).	XXX	3
	6-9	TIME OF DAY IN HOURS AND MINUTES.	XXXX	4

X = NUMERICAL

RECORD FORMAT = FIXED LENGTH
RECORD LENGTH = 80 BYTES
MEDIUM USED = PUNCHED CARD

NOTE. ALL ENTRIES RIGHT JUSTIFIED IN COLUMNS SPECIFIED WITH LEADING ZEROES.

FIGURE 8. T4SERCH CONTROL CARD

763031842

TIME	TYPE	CHAN.	GRP. NO.	GRP. ADDR.	MEAN TIME	STANDARD DEVIATION	NO. SAMPLES	SWITCH 0 1 2 3 4 5 6 7 8 9 A B C D E F
23.46999	HNAL	79			0.			
23.46999	HNAL	80			4913.			
24.58998	HFAL	79			379.	141.	100	
30.02998	DI		5					1 0 0 0 1 0 1 0 1 0 0 0 1 1 0 0
30.08998	DI		5					1 1 0 0 1 0 1 0 1 0 0 0 1 1 0 0
30.23999	DI		13					0 0 0 0 0 0 0 0 0 1 1 0 1 1 1 1
25.00999	HFAL	80			391.	78.	89	
29.81999	HNAL	80			579.			
31.14998	DI		5					1 0 0 0 1 0 1 0 1 0 0 0 1 1 0 0
31.35999	DI		5					1 1 0 0 1 0 1 0 1 0 0 0 1 1 0 0
31.67999	DI		5					1 0 0 0 1 0 1 0 1 0 0 0 1 1 0 0
31.73999	DI		5					1 1 0 0 1 0 1 0 1 0 0 0 1 1 0 0
31.78999	DI		5					1 0 0 0 1 0 1 0 1 0 0 0 1 1 0 0
31.88998	DI		5					1 1 0 0 1 0 1 0 1 0 0 0 1 1 0 0
33.54999	DI		5					1 0 0 0 1 0 1 0 1 0 0 0 1 1 0 0
33.65999	DI		5					1 1 0 0 1 0 1 0 1 0 0 0 1 1 0 0
33.70999	DI		5					1 0 0 0 1 0 1 0 1 0 0 0 1 1 0 0
33.75998	DI		5					1 1 0 0 1 0 1 0 1 0 0 0 1 1 0 0
34.12999	DI		5					1 0 0 0 1 0 1 0 1 0 0 0 1 1 0 0

FIGURE 9. T4SIMOUT Printout

Decimal Address	Point Number(s)	Use or Meaning
64	0-15	SPC-16 Single Addressing
65	0-15	Discrete Switches
66	0-15	Unused
	0-3	Unused
	4	Start/Stop Switch
67	5	Pretest Mode Advance Switch
	6	Pretest Mode Repeat Switch
	7-15	Unused
68	0-15	Discrete Switches
69	0-15	Discrete Switches
70	0-15	Discrete Switches
71	0-15	Discrete Switches
72	0-15	Discrete Switches
73	0-15	Discrete Switches
74	0-15	Discrete Switches
75	0-15	Discrete Switches
76	0-15	Discrete Switches
77	0-15	Discrete Switches
78	0-15	Discrete Switches
79	0-15	Discrete Switches

TABLE 2. DIGITAL INPUT ADDRESSING

Decimal Address	Point Number(s)	Use or Meaning
80	0-15	Discrete Switches
81	0-15	Discrete Switches
82	0-15	Discrete Switches
83	0-15	Discrete Switches
84	0-15	Discrete Switches
85	0-15	Discrete Switches
86	0-6	Discrete Switches
86	7	Restart Switch
86	8-15	Discrete Switches

TABLE 2. DIGITAL INPUT ADDRESSING (Concluded)

Decimal Address	Point Number(s)	Use or Meaning
113	0-15	Emitter Station Control Switches
114	0-15	Emitter Station Control Switches
115	0-15	Emitter Station Control Switches
116	0-15	Emitter Station Control Switches
117	0-15	Emitter Station Control Switches
118	0-15	Emitter Station Control Switches
119	0-5	Emitter Station Control Switches
119	6	Reset Command
119	7-15	Unused
120	0-15	Unused
121	0-15	Unused
122	0-15	Unused
123	0-15	Unused
124	0-15	SPC-16 Single Addressing
125	0-15	External Electronic Clock Control Switch

TABLE 3. DIGITAL OUTPUT ADDRESSING

SECTION VI

PROGRAM CARD DECKS

Source program card decks and program object decks for the T4 EWO programs are available at the Systems Research Branch, Human Engineering Division of AMRL. A set of printed listings of the source code is also available, both in card image format and assembled format. This data is stored on magnetic tape, AMRL serial number 000409. File 22 contains the program object decks with Job Control Language (JCL), for link-editing the subroutines. File 23 contains the source code, with JCL, for assembling and compiling the entire set of subroutines. Both files are in card image format, fixed length, 80 byte records, 3200 bytes per block. Figure 10 lists the link-edit decks used for both the T4 EWO programs and the T4 utility programs. For ease of handling, the SYSPUNCH output from the assembler and compiler are all stored in a partitioned data set called IBM-PMSESA. At link-edit time, the various subroutines are then retrieved using INCLUDE statements as shown in Figure 10, and link-edited onto SYS1-HESSLINK, the systems program library. Figure 11 lists the T4EXEC deck.

Following each run the output data must be transferred to a tape and a reserved disk pack for historical purposes. Figure 12 lists the T4COPY execute deck used for this data transfer.

At the conclusion of each run the output data is reformatted and sorted in the proper 'time' sequence for the analysis program. Figures 13 and 14 list the two execution decks for invoking the two programs. Figure 15 lists the execution deck used for retrieving data that had previously been stored on the backup files.

At the end of an experiment, a quick look printout is generated by the T4SIMOUT Program and may be obtained. The execution deck used to generate this printout is listed in Figure 16.

```
//LINKT4    JOB  BRANDT,MSGLEVEL=1
//  EXEC  LINK
//LKED.SYSLMOD DD DSN=IBM.EXEC(T4ENEW),DISP=SHR,VOL=SER=SYSTEM
//LKED.MY   DD DSN=IBM.PMSESA,DISP=SHR,VOL=SER=SYSTEM,UNIT=DISK
//LKED.SYSIN  DD *
 INCLUDE MY(REALT4)
 INCLUDE MY(READRR)
 INCLUDE MY(CONVT)
 INCLUDE MY(SIGMA)
/*
```

T4REAL LINK-EDIT

```
//LKT4COPY   JOB  BRANDT,MSGLEVEL=1
//  EXEC  LINK
//LKED.SYSLMOD  DD  DSN=IBM.EXEC(T4COPPY),DISP=SHR,VOL=SER=SYSTEM
//LKED.MY  DD DSN=IBM.PMSESA,DISP=SHR,VOL=SER=SYSTEM,UNIT=DISK
//LKED.SYSIN  DD *
 INCLUDE MY(T4COPY)
/*
```

T4COPY LINK-EDIT

```
//LKT4FRMT   JOB  BRANDT,MSGLEVEL=1
//  EXEC  LINK
//LKED.SYSLMOD  DD  DSN=IBM.EXEC(T4FORMAT),DISP=SHR,VOL=SER=SYSTEM
//LKED.MY  DD DSN=IBM.PMSESA,DISP=SHR,VOL=SER=SYSTEM,UNIT=3330
//LKED.SYSIN  DD *
 INCLUDE MY(T4FRMT)
/*
```

T4FORMAT LINK-EDIT

```
//LKT4SRCH   JOB  BRANDT,MSGLEVEL=1
//  EXEC  LINK
//LKED.SYSLMOD  DD  DSN=IBM.EXEC(T4SEARCH),DISP=SHR,VOL=SER=SYSTEM
//LKED.MY  DD DSN=IBM.PMSESA,DISP=SHR,VOL=SER=SYSTEM,UNIT=DISK
//LKED.SYSIN  DD *
 INCLUDE MY(T4SERCH)
/*
```

T4SEARCH LINK-EDIT

```
//LNKSMOT    JOB  BRANDT,MSGLEVEL=1
//  EXEC  LINK
//LKED.SYSLMOD DD DSN=IBM.EXEC(T4SIMOT),DISP=SHR,VOL=SER=SYSTEM
//LKED.MY  DD DSN=IBM.PMSESA,DISP=SHR,VOL=SER=SYSTEM,UNIT=DISK
//LKED.SYSIN  DD *
 INCLUDE MY(T4SMOT)
 INCLUDE MY(T4CNVT)
/*
```

T4SIMOUT LINK-EDIT

FIGURE 10. PROGRAM LINK-EDIT DECKS

```
//T4EXEC      JOB    MSGLEVEL=1,CLASS=C
//STEP1       EXEC   PGM=T4ENEW
//STEPLIB     DD     DSN=IBM.EXEC,DISP=SHR,VOL=SER=SYSTEM,UNIT=DISK
//EWODATA     DD     DSN=T4.EWODATA,UNIT=3330,VOL=SER=SYSTEM,
//                   DISP=(OLD,KEEP),SPACE=(CYL,(5,5),RLSE)
//DDOUT       DD     UNIT=005
//DDIGN       DD     UNIT=004
//PRINT       DD     SYSOUT=A,DCB=(BUFNO=20)
//SYSUDUMP    DD     SYSOUT=A
//FT06F001    DD     SYSOUT=A
//FT05F001    DD     *
CT      1  CT CARD GOES HERE
JA     26  JA THRESHOLD DATA CARDS GO HERE
TW      1  TW IDENTIFIER CARD GOES HERE
TW      7  TW THRESHOLD DATA CARDS GO HERE
MA      1  MA IDENTIFIER CARD GOES HERE
MA      1  MA THRESHOLD DATA CARD GOES HERE
RF      1  RF THRESHOLD DATA CARD GOES HERE
TR     75  TR THRESHOLD DATA CARDS GO HERE
/*
```

FIGURE 11 T4REAL EXECUTION DECK.

```
//T4COPY    JOB MSGLEVEL=1,CLASS=A

//STEP1     EXEC  PGM=T4COPPY
//STEPLIB   DD  DSN=IBM.EXEC,DISP=SHR
//EWODATA   DD  DSN=T4.EWODATA,UNIT=3330,DISP=SHR,VOL=SER=SYSTEM
//DSKCOPY   DD  DSN=T4.DSKCOPY,UNIT=3330,DISP=(MOD,KEEP),VCL=SER=SYSTEM,
//              SPACE=(CYL,(5,5),RLSE)
//TAPECPY   DD VOL=SER=000416,LABEL=(,NL),UNIT=180,DISP=(MCD,KEEP),DSN=T
//SYSUDUMP  DD  SYSOUT=A
/*
//
```

FIGURE 12 T4COPY EXECUTE DECK.

```
//T4FORMAT JOB MSGLEVEL=1,CLASS=A
//STEP1     EXEC  PGM=T4FORMAT
//STEPLIB   DD   DSN=IBM.EXEC,DISP=SHR
//EWODATA   DD   DSN=T4.EWODATA,UNIT=3330,DISP=SHR,VOL=SER=SYSTEM
//FMTDATA   DD   UNIT=3330,VOL=SER=SYSTEM,DISP=OLD,DSN=T4.ANALYSIS,
//               SPACE=(CYL,(5,5),RLSE)
//DSKCOPY   DD   DSN=T4.DSKCOPY,UNIT=3330,DISP=OLD,VOL=SER=SYSTEM
//SYSUDUMP  DD   SYSOUT=A
//CTLCD     DD   *
DISK
/*
```

FIGURE 13 T4FORMAT EXECUTE DECK.

```
//T4SORT     JOB
//STEP1      EXEC  PGM=IERRC000
//SORTLIB    DD  DSNAME=SYS1.SORTLIB,DISP=SHR
//SYSOUT     DD  SYSOUT=A
//SORTIN     DD UNIT=3330,VOL=SER=SYSTEM,DISP=OLD,DSN=T4.ANALYSIS,
//              DCB=(RECFM=VSB,LRECL=28,BLKSIZE=3224)
//SORTOUT    DD UNIT=3330,VOL=SER=SYSTEM,DISP=(OLD,KEEP),DSN=T4.FMTDATA,
//              SPACE=(CYL,(5,5),RLSE),
//              DCB=(RECFM=VSB,LRECL=28,BLKSIZE=3224)
//SORTWK01   DD UNIT=3330,SPACE=(TRK,(40),,CONTIG)
//SORTWK02   DD UNIT=3330,SPACE=(TRK,(40),,CONTIG)
//SORTWK03   DD UNIT=3330,SPACE=(TRK,(40),,CONTIG)
//SORTWK04   DD UNIT=3330,SPACE=(TRK,(40),,CONTIG)
//SORTWK05   DD UNIT=3330,SPACE=(TRK,(40),,CONTIG)
//SORTWK06   DD UNIT=3330,SPACE=(TRK,(40),,CONTIG)
//SYSUDUMP   DD SYSOUT=A
//SYSIN      DD *
 SORT FIELDS=(13,4,BI,A,17,4,BI,A),SIZE=E5000
 RECORD TYPE=V,LENGTH=(28,,28)
END
/*
```

FIGURE 14 T4SORT EXECUTE DECK.

```
//T4SERCH   JOB
//STEP1       EXEC   PGM=T4SEARCH
//STEPLIB     DD   DSN=IBM.EXEC,DISP=SHR
//P6SRCHD     DD   DSN=T4.EWODATA,DISP=(OLD,KEEP),UNIT=3330,
//                   VOL=SER=SYSTEM
//EWODATA     DD   DSN=T4.DSKCOPY,DISP=OLD,UNIT=3330,VOL=SER=SYSTEM
//SYSUDUMP    DD   SYSOUT=A
//CTLCD       DD   *
762641017
/*
```

FIGURE 15 T4SERCH EXECUTE DECK.

```
//SIMEXEC   JOB BRANDT
//STEP1   EXEC PGM=T4SIMOT
//STEPLIB   DD   DSN=IBM.EXEC,DISP=SHR
//FT08F001   DD DSN=T4.EWDDATA,UNIT=3330,DISP=OLD,VOL=SER=SYSTEM
//FT06F001   DD   SYSOUT=A
/*
//
```

FIGURE 16 SIMEXEC EXECUTION DECK.

SECTION VII

PROGRAM FLOWCHARTS

The program flowcharts are presented in Figures 17 thru 21. These machine-produced flowcharts were generated by AUTODOC-V. The conventions used in these flowcharts are described in "AUTODOC-V -- an Automatic Documentation and Symbolic Flow Charting Program," 360D-001-1-014, available at the Systems Research Branch, Human Engineering Division of AMRL.

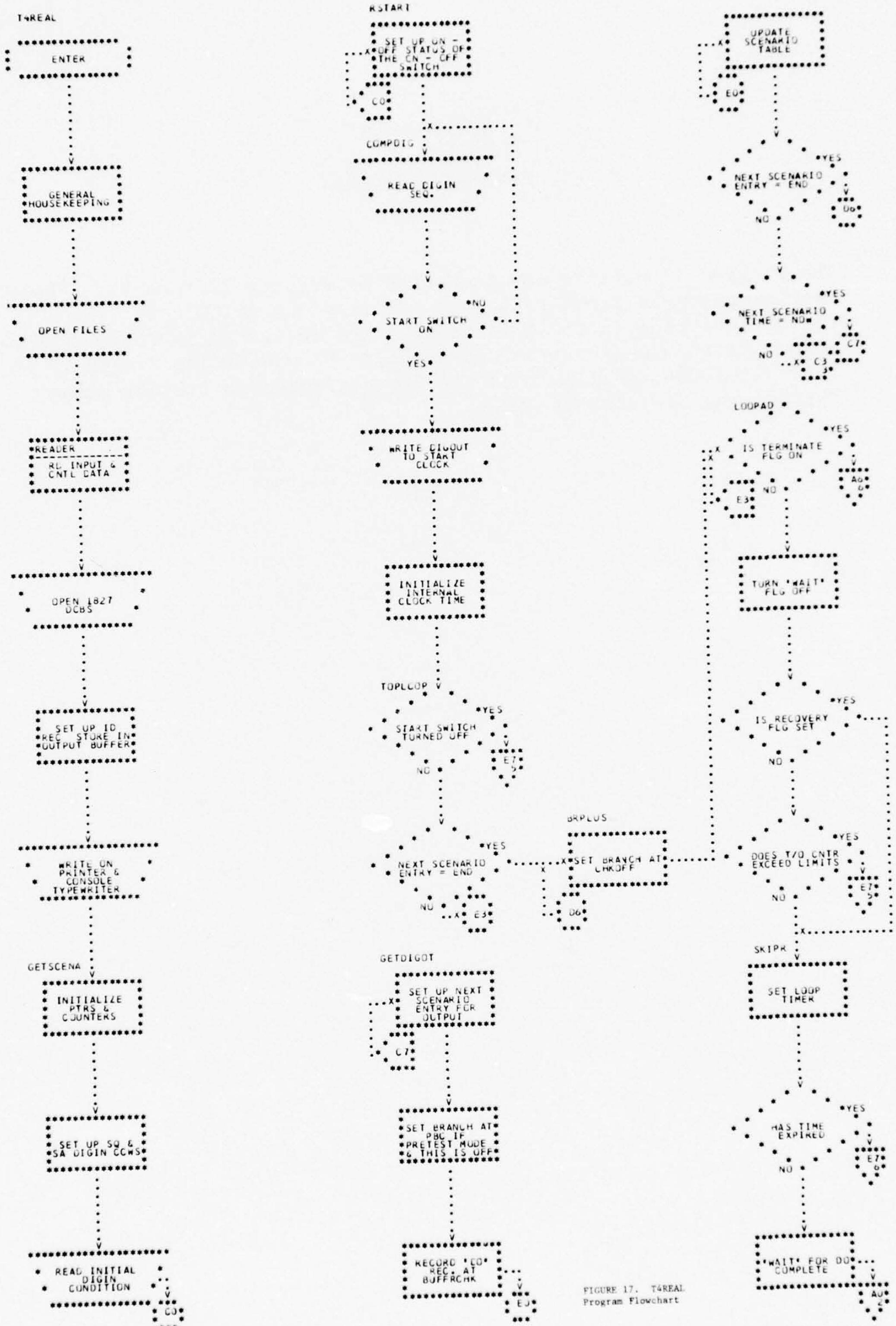

FIGURE 17. T4REAL Program Flowchart

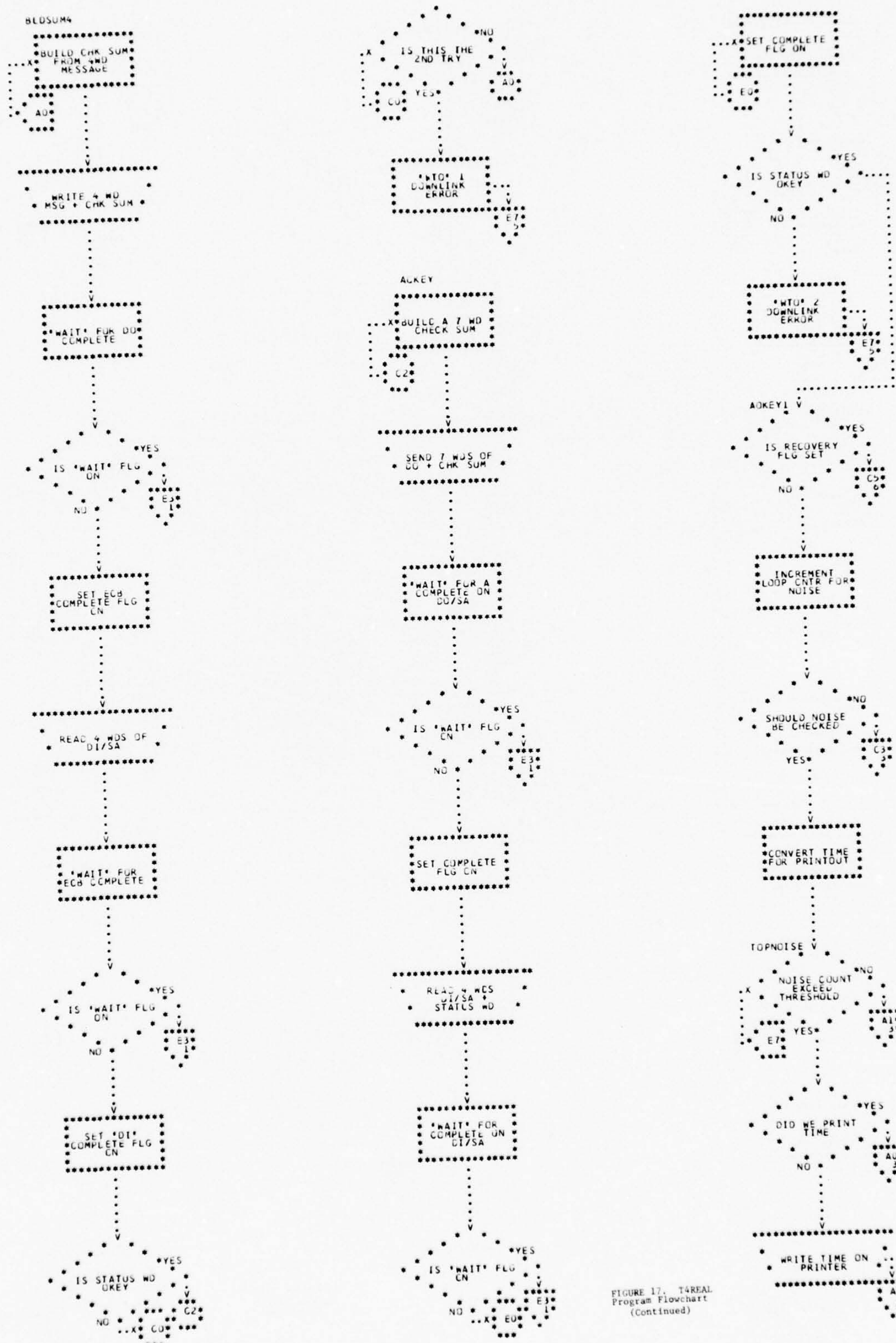

FIGURE 17. T4REAL Program Flowchart (Continued)

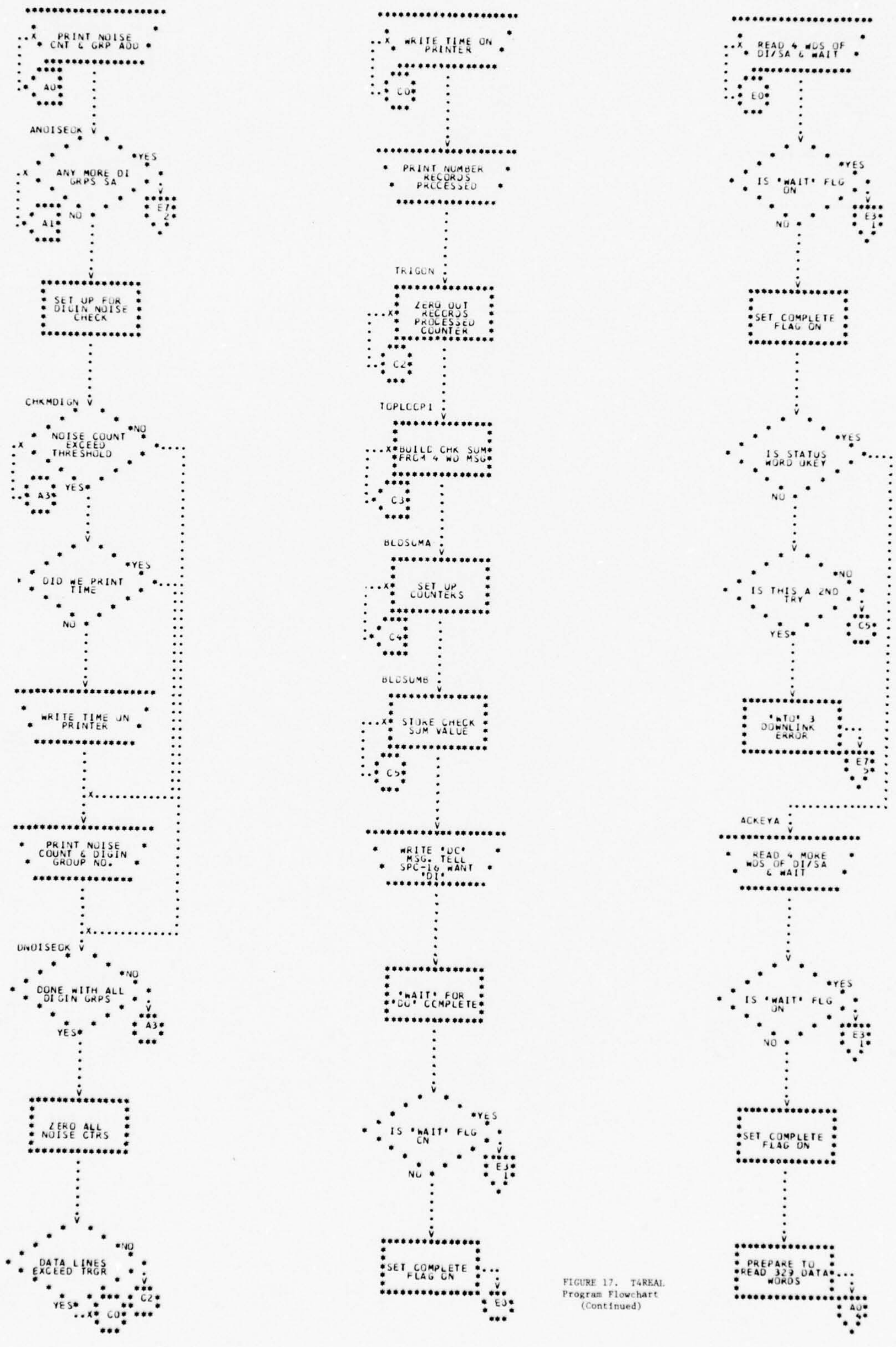

FIGURE 17. T4REAL Program Flowchart (Continued)

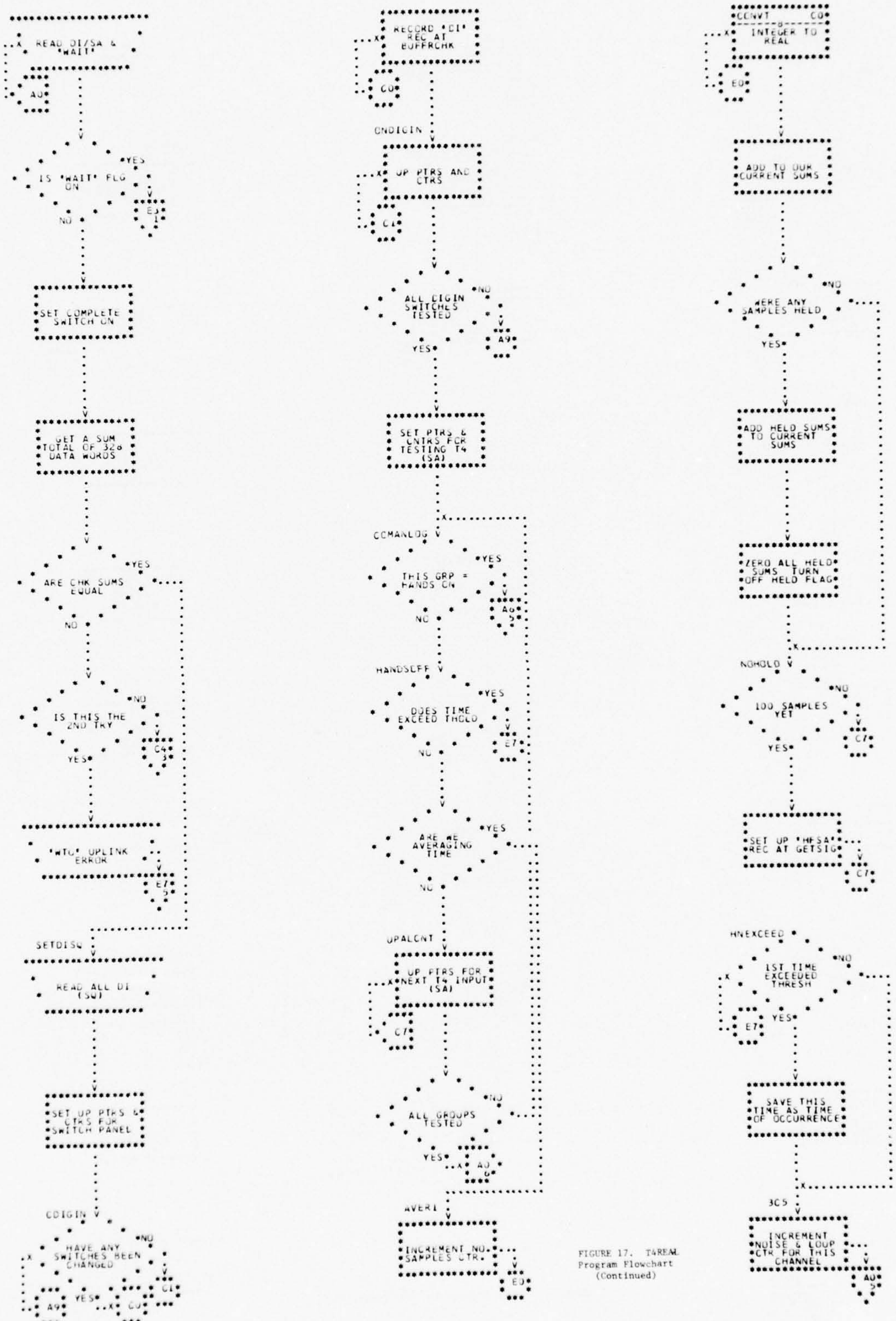

FIGURE 17. T4REAL Program Flowchart (Continued)

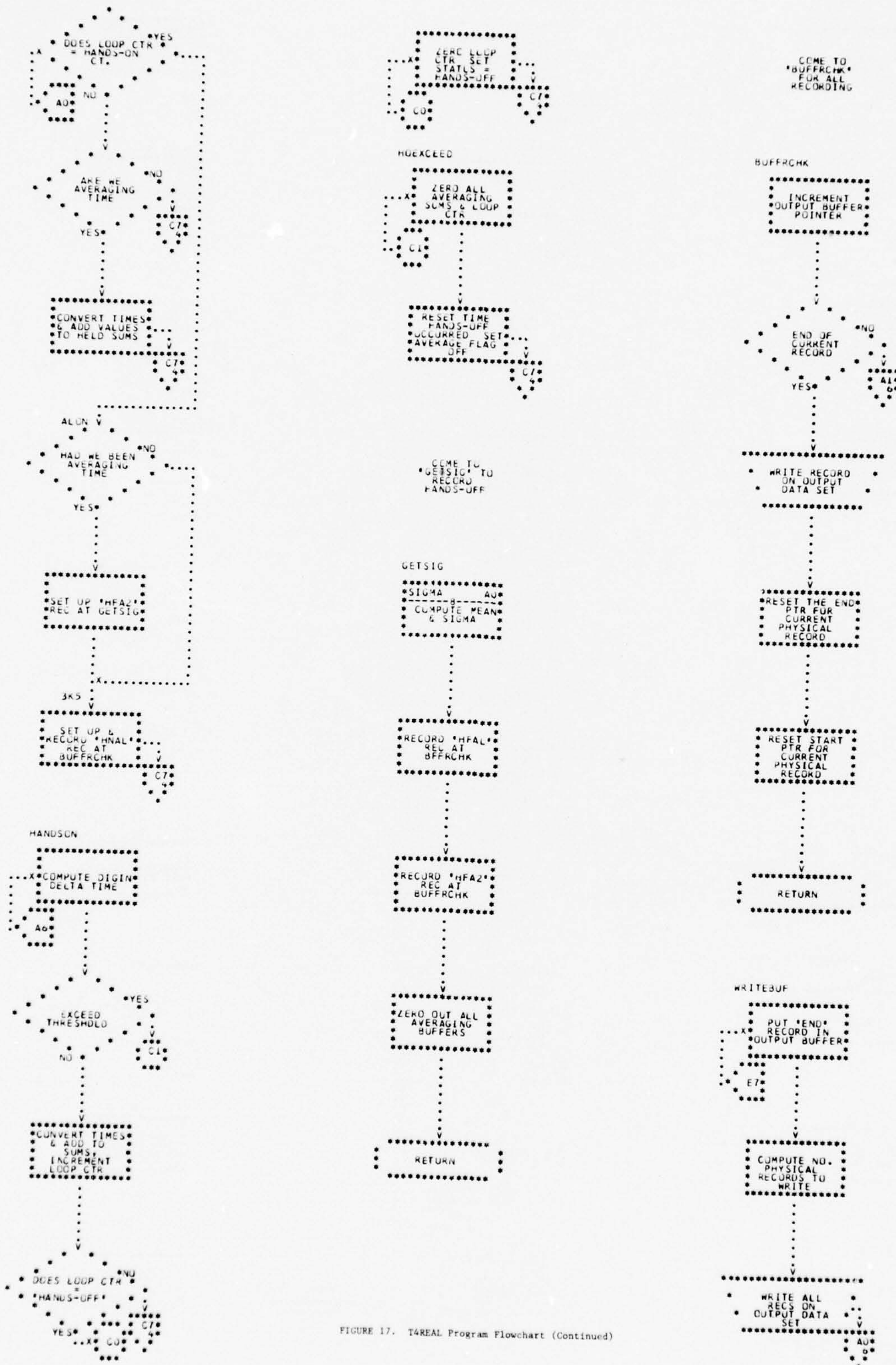

FIGURE 17. T4REAL Program Flowchart (Continued)

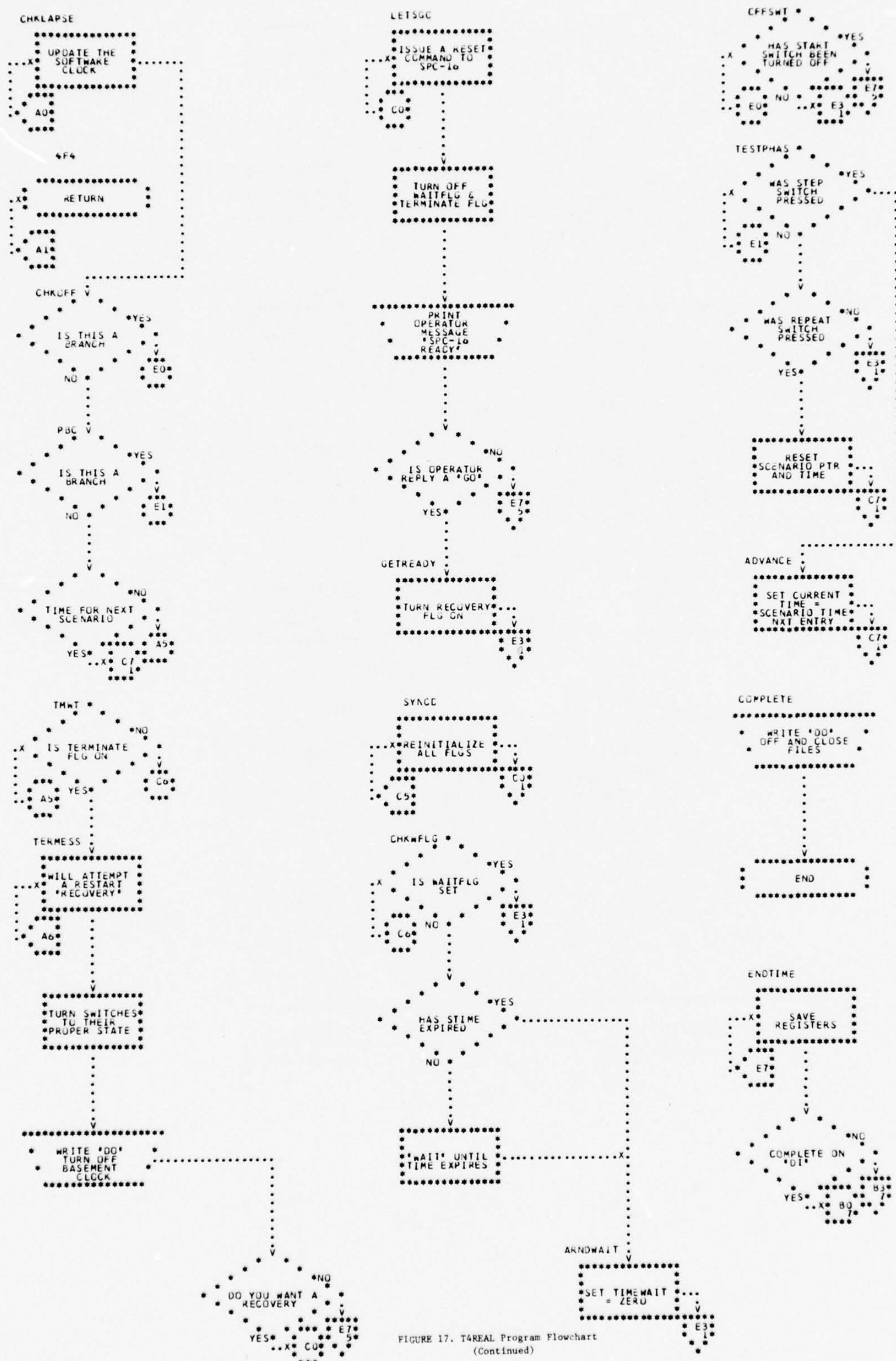

FIGURE 17. T4REAL Program Flowchart
(Continued)

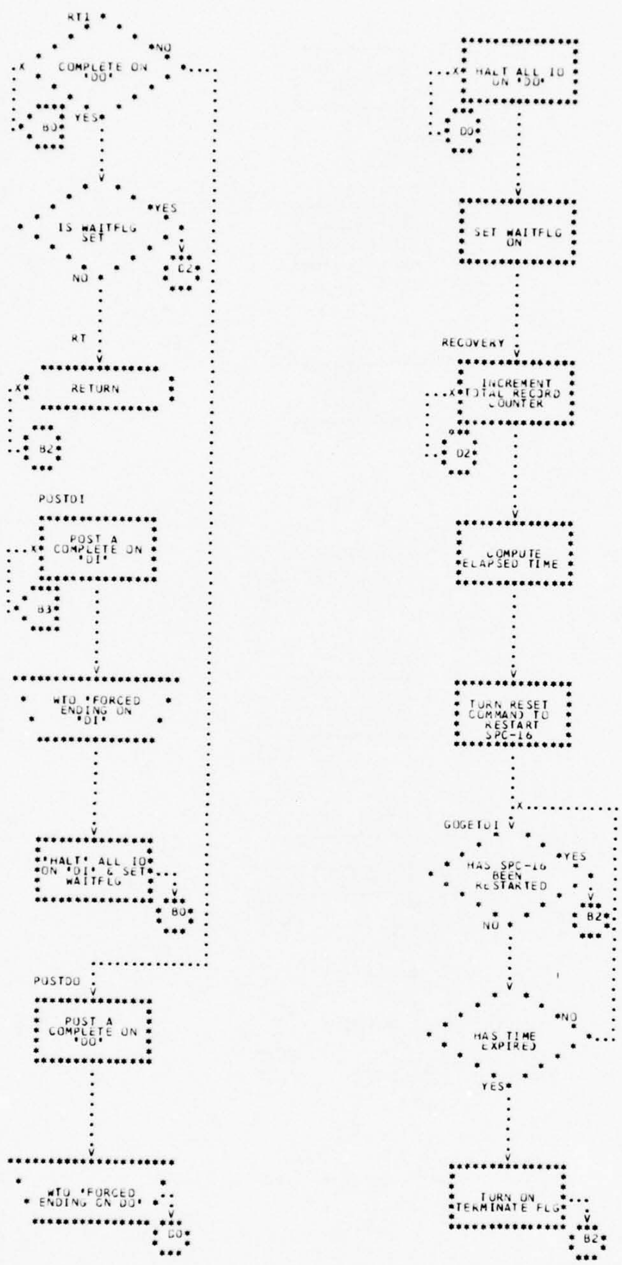

FIGURE 17. T4REAL Program Flowchart (Continued)

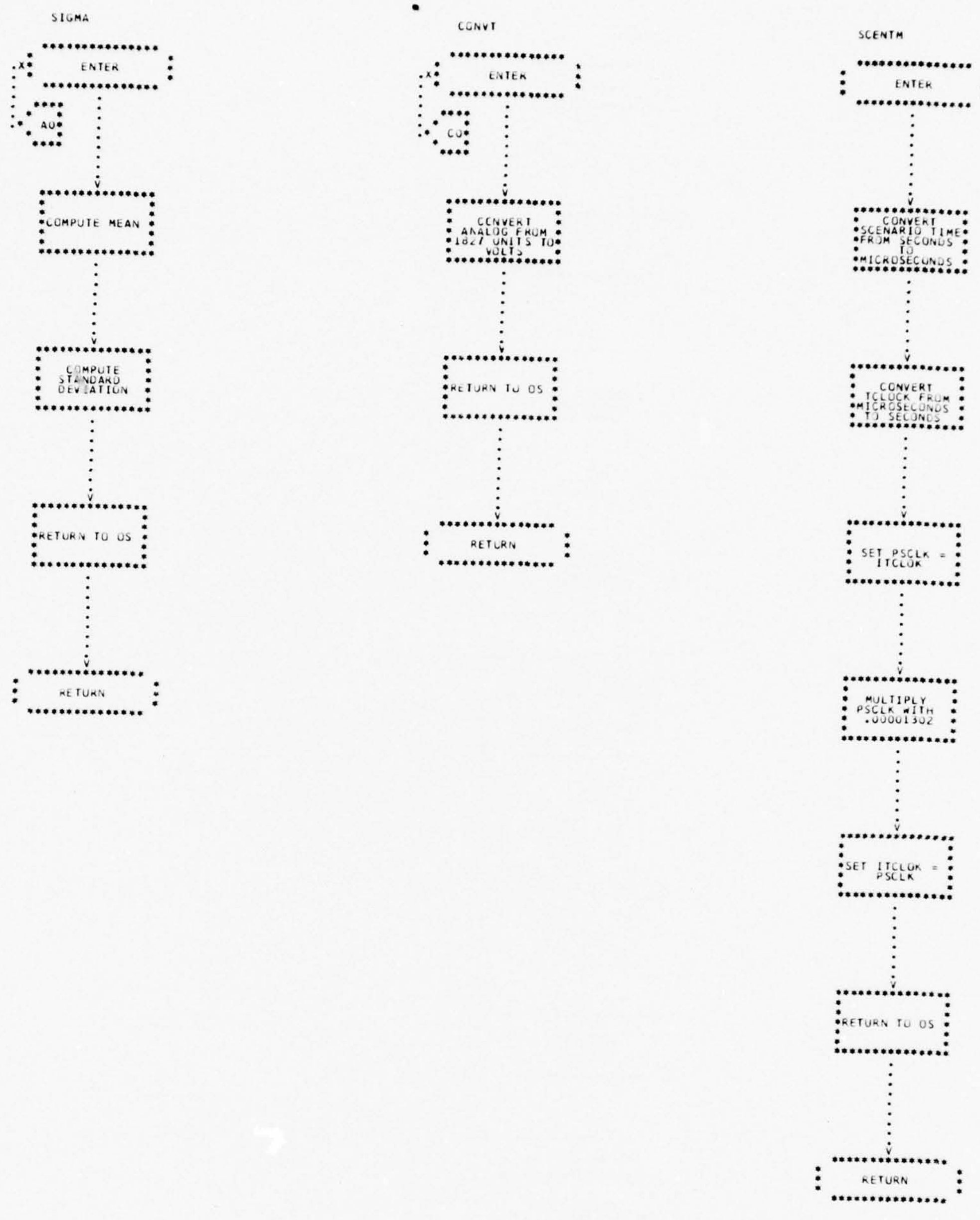

FIGURE 17. T4REAL Program Flowchart (Concluded)

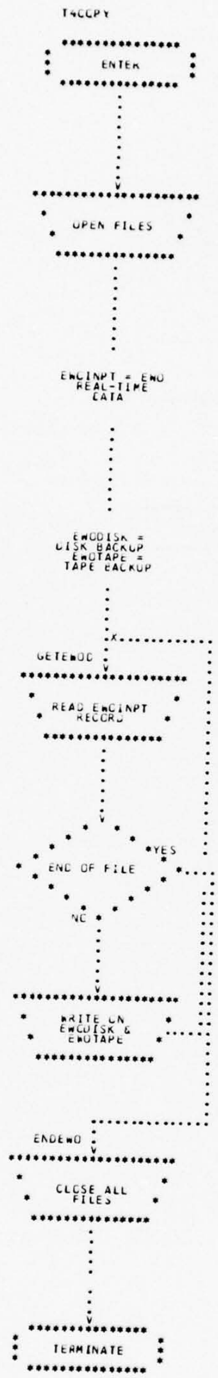

FIGURE 18. T4COPY Program Flowchart

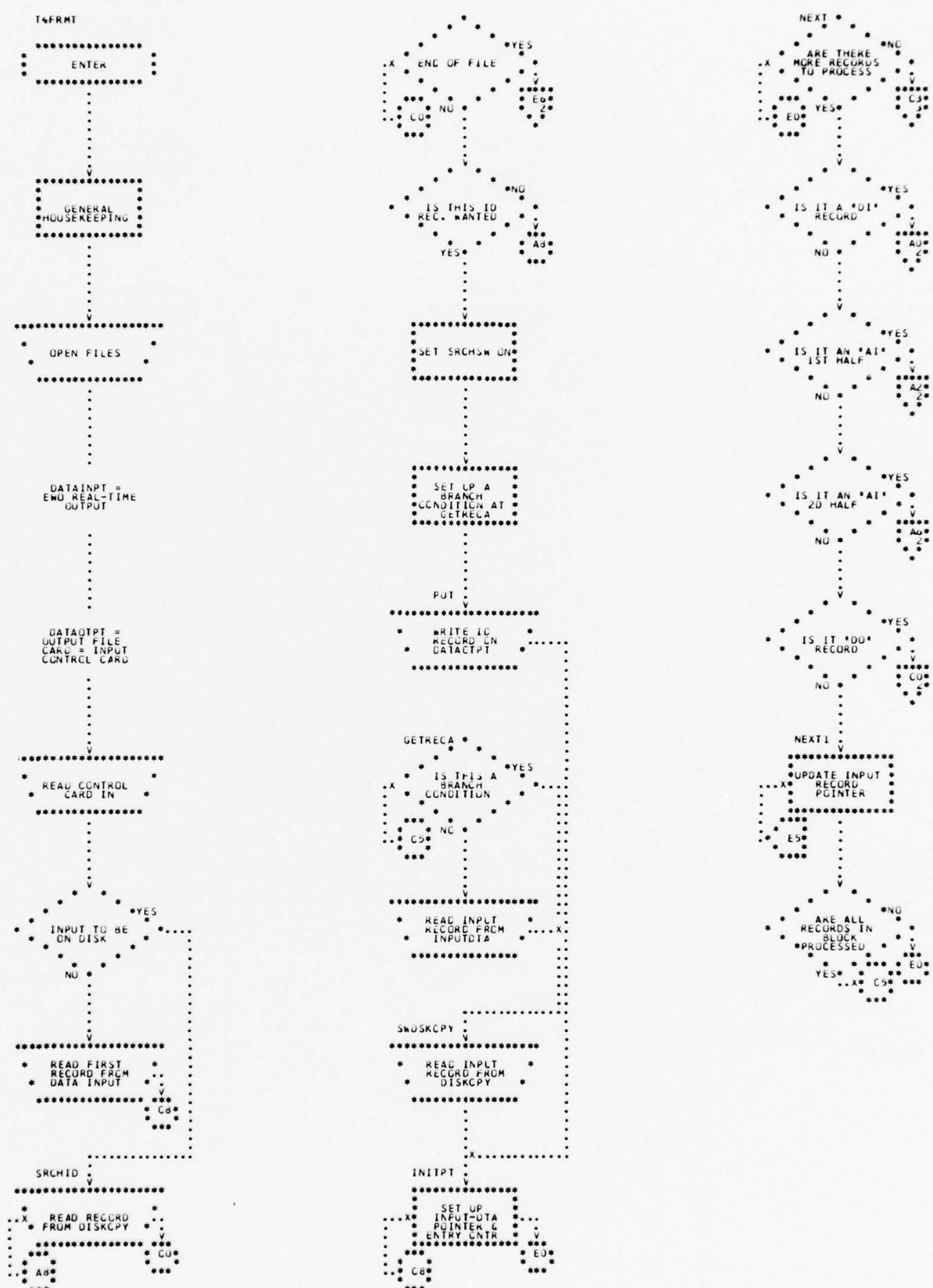

FIGURE 19. T4FRMT Program Flowchart

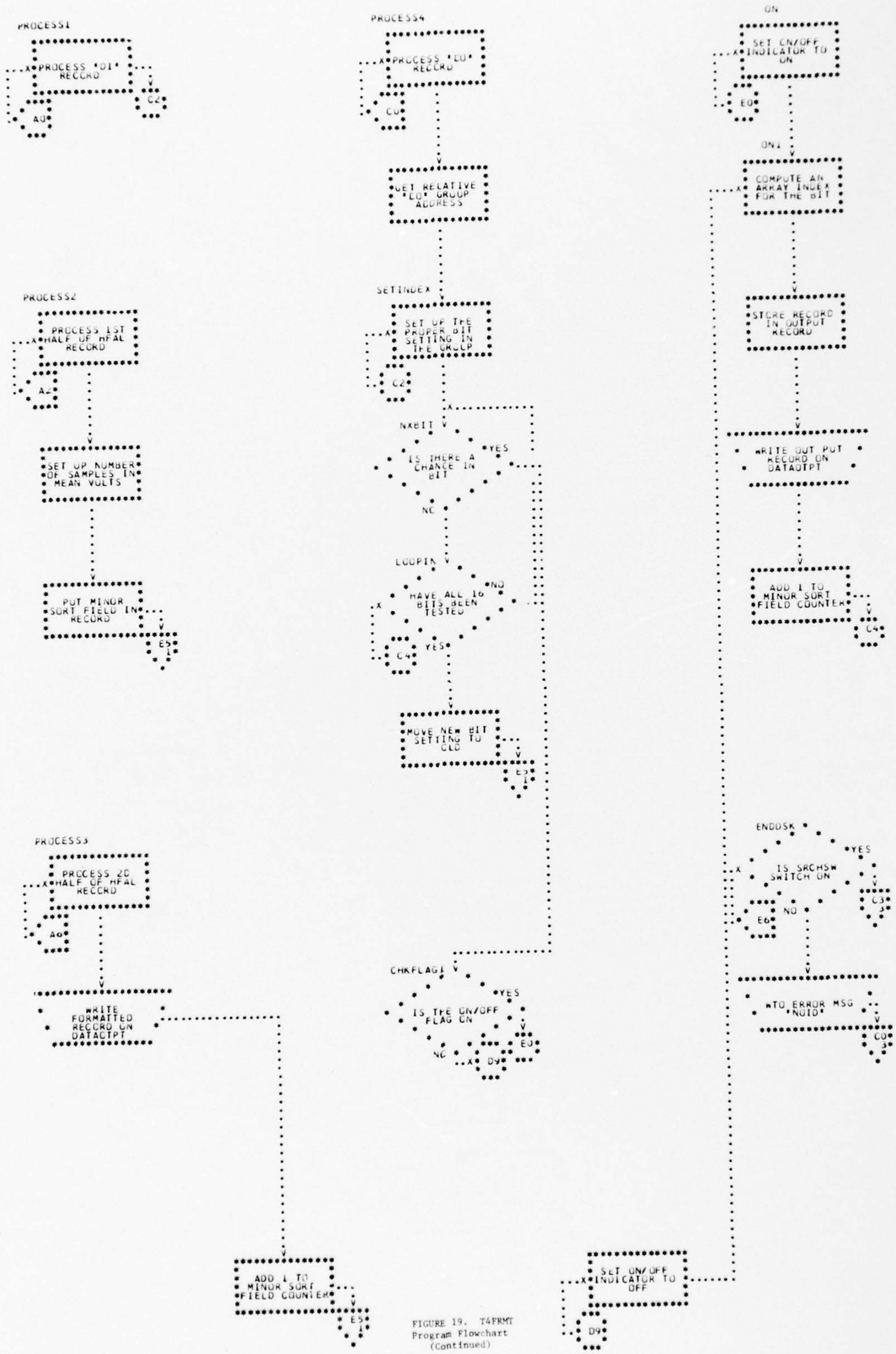

FIGURE 19. T4FRMT
Program Flowchart
(Continued)

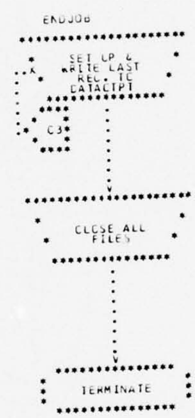

FIGURE 19. T4FRMT Program Flowchart (Concluded)

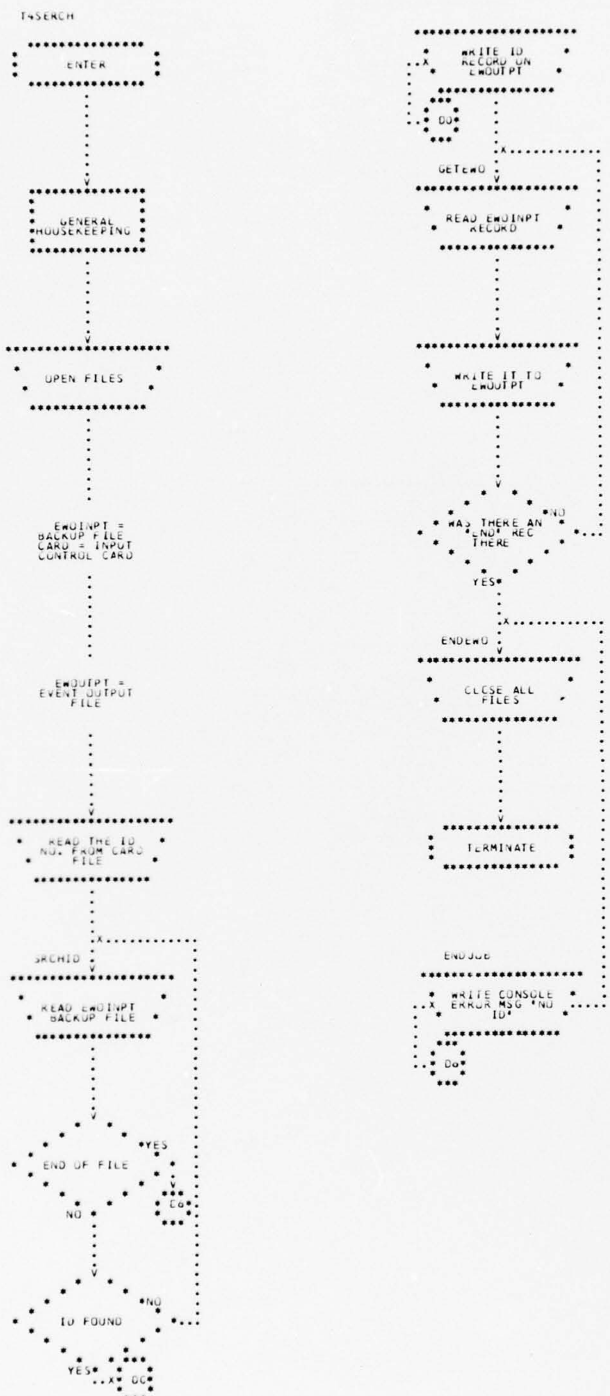

FIGURE 20. T4SERCH Program Flowchart

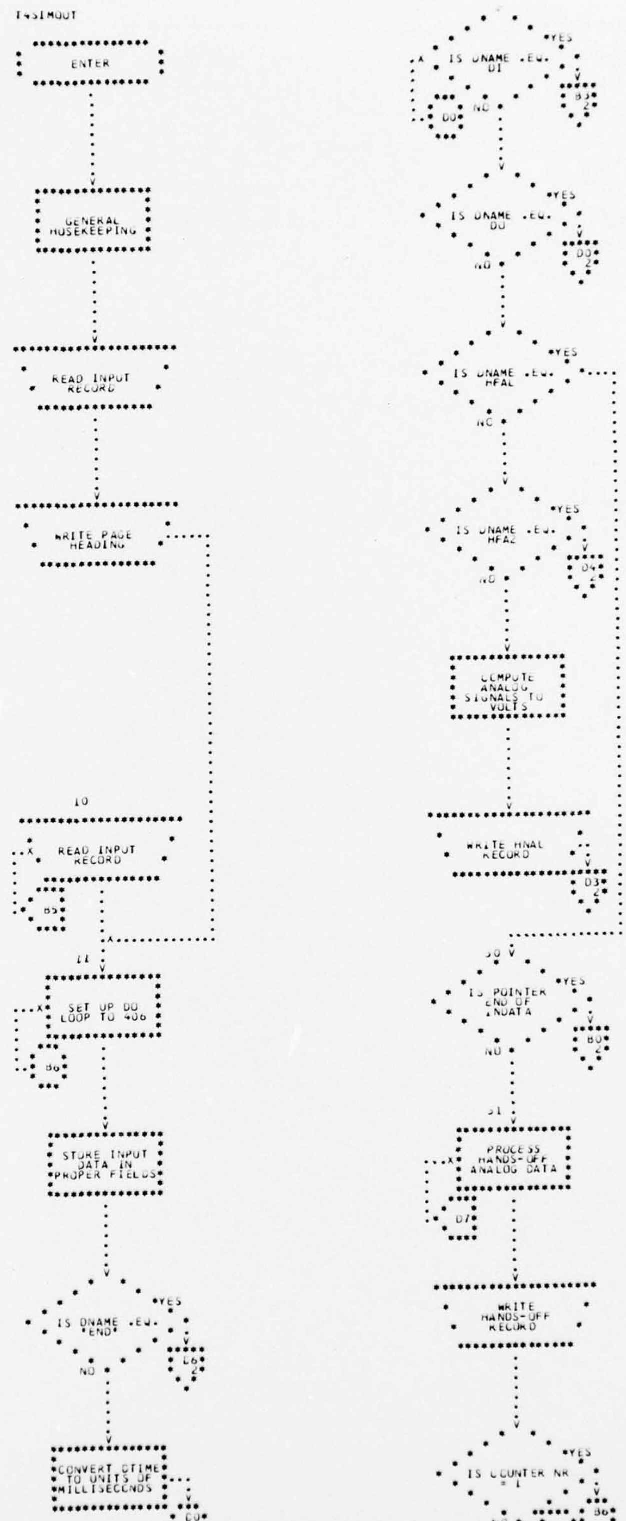

FIGURE 21. T4SIMOUT Program Flowchart

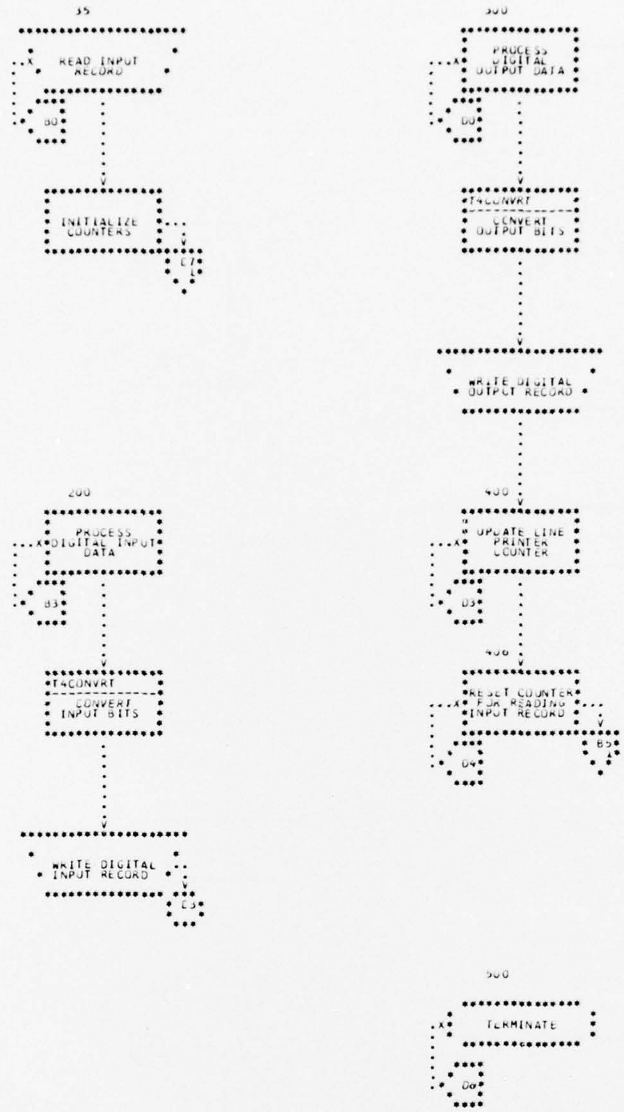

FIGURE 21. T4SIMOUT Program Flowchart (Continued)

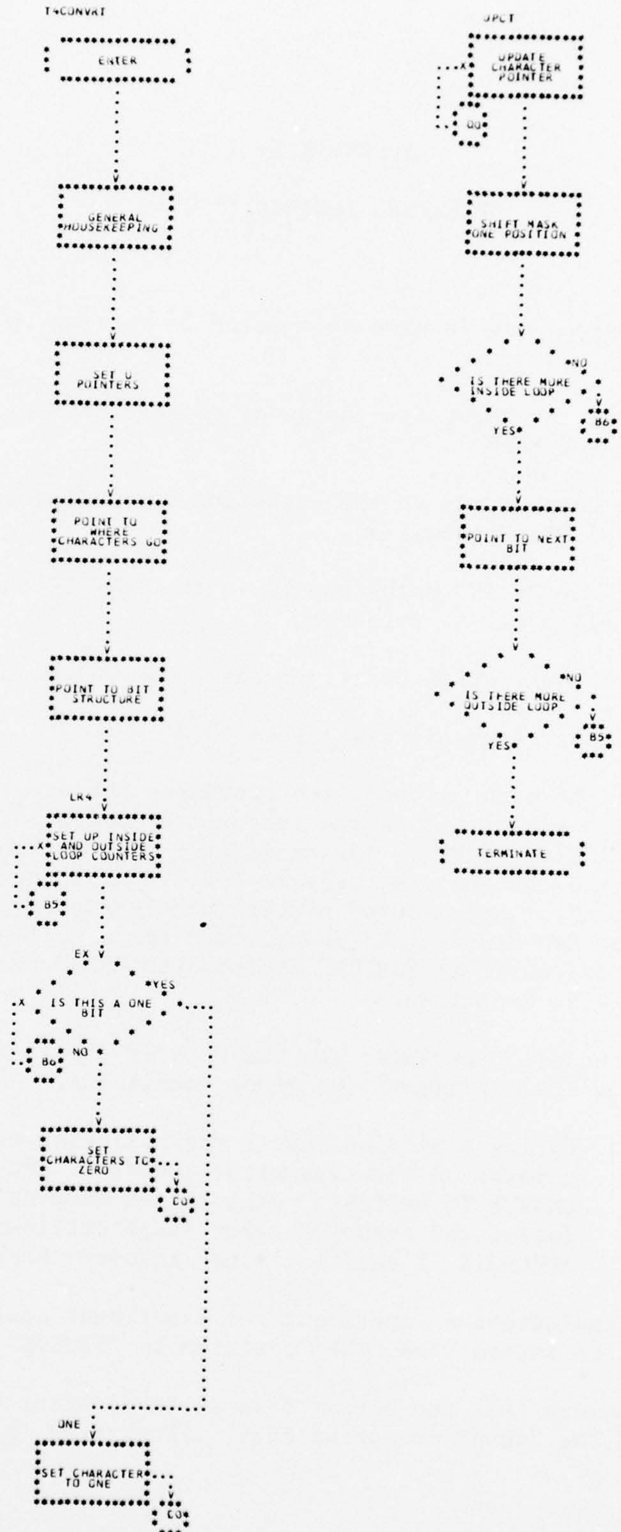

FIGURE 21. T4SIMOUT Program Flowchart (Concluded)

APPENDIX I

OPERATING INSTRUCTIONS

The following steps may be used as a guide in setting up the system for execution.

1. Prepare the input data cards as defined in Section V, Figures 1 thru 3.

2. Place these cards in the execution deck illustrated in Section VI, Figure 11.

3. Place the T4 EWO patch panels in the 1827 DCU and make sure all power is turned on.

4. Load the execution deck into the card reader and ready it.

5 Mount the requested disk packs.

6. After the program reads and processes the input data, a message will print on the typewriter console 'WAITING FOR MISSION START'. The experiment monitor should be informed that all is ready in the computer room. When the monitor has assured himself that everything is ready at the EWO station, he should turn the experiment control switch from "FREEZE" position to "RUN" position to begin the experiment.

7. The console typewriter and the printer should be monitored during the experiment for error conditions.

   NOTE: During a mission run if the following message appears on the typewriter console, 'SPC-16 UNABLE TO RESTART. WILL TRY TO RECOVER', follow the error recovery steps outlined in APPENDIX II entitled Error Recovery Procedures.

8. To terminate the experiment the experiment control switch must be turned from "RUN" position to "FREEZE" position.

9. To ensure that the output data is saved after each run, load the T4COPY execution deck, illustrated in Section VI,

Figure 12, into the card reader and ready it.

10. Mount the disk packs and/or tape volumes as specified on the console typewriter. After the T4COPY job is completed, if a printout of the quick look program is desired, proceed to Step 11. If no quick look is desired, remove the execution deck from the card reader and the printout from the printer. Record all pertinent information from the console typewriter.

11. Load the SIMEXEC execution deck illustrated in Section VI, Figure 16, into the card reader and ready it.

12 Mount the disk packs as specified on the console typewriter. After the SIMEXEC job is completed remove the execution deck from the card reader and the printout from the printer. Record all pertinent information from the console typewriter.

APPENDIX II

ERROR RECOVERY PROCEDURES

There are two sets of error recovery steps available to the user when executing programs in the T4 EWO System. The first set should be used by the operator when the following three messages are printed on the console typewriter: 'SPC-16 UNABLE TO RESTART. WILL TRY TO RECOVER', 'RESET MISSION START/STOP SWITCH TO FREEZE', and 'SPC-16 RECOVERY. REPLY GO OR NO'.

The following steps may be used as a guide when executing the first set of error recovery steps:

1. After the three messages are printed on the console typewriter, the computer operator and the experiment monitor must make a decision whether to terminate the experiment or to proceed with the recovery. To terminate the experiment proceed to Step 2. To continue with the recovery proceed to Step 3.

2. The computer operator must type in the following message reply: r oo, 'NO'. This will cause the output data to be written to disk and the job will terminate.

3. The computer operator must inform the experiment monitor to reset the mission START/STOP switch to "FREEZE" position.

4. Now, the experiment monitor must reload the SPC-16 program. After he has assured himself that everything is ready at the EWO station, he must also inform the computer operator of the ready status.

5. The computer operator must type in the following message reply: r oo, 'GO'. This causes the program to go through a reinitialization, and a message to be printed on the console typewriter: 'WAITING FOR MISSION START'. This message informs the computer operator that the mission is ready to begin.

6. The computer operator must inform the experiment monitor to reset the mission START/STOP switch to "RUN" position. This causes the experiment to begin.

7. Each time the three messages mentioned at the beginning of the Error Recovery Procedures are printed on the console typewriter, the operator must repeat Steps 1 thru 10.

8. To terminate the experiment, the experiment control switch must be turned from "RUN" position to "FREEZE" position.

9. To ensure that the output data is saved after the mission is completed, load the T4COPY execution deck illustrated in Section VI, Figure 12, into the card reader and ready it.

10. After the T4COPY program has terminated, remove the execution deck from the card reader and the printout from the printer. Record all pertinent information from the console typewriter.

The second set of recovery steps should be used when the message: 'T4EXEC - STEP1 ABEND Uo555' is printed on the console typewriter.

The following steps may be used by the computer operator when executing the second error recovery steps.

1. The computer operator must inform the experiment monitor to reset the mission START/STOP switch to "FREEZE" position.

2. Now, the experiment monitor must reload the SPC-16 program. After he has assured himself that everything is ready at the EWO station, he must also inform the computer operator of the ready status.

3. The computer operator must enter the new start clock time on the control card 'CT' shown in Section V, Figure 1, Columns 6 thru 13. The new start clock time represents the length of time the experiment ran before terminating, plus the original mission start time. Example: If the original mission start time were 080010 where 08 = hours, 00 = minutes and 10 = seconds, and the mission terminated at 093010. The new mission start time would be 080010 plus 013000. This equates to 093010.

4. After the new control card 'CT' has been corrected to reflect the new start clock time, the computer operator must turn to APPENDIX I, titled Operating Instructions, and proceed with Steps 1 thru 12.

APPENDIX III

CONSOLE TYPEWRITER MESSAGES

The following user written messages will be printed on the console typewriter in the event that the program is forced to take an abnormal ending, or if a program restart is necessary.

Console Typewriter Messages	Explanation
1. Down Link Error	Unsuccessful in sending four word message to SPC-16. Job is terminated.
2. Down Link Error	Unsuccessful in sending seven words of data to SPC-16. Job is terminated.
3. Down Link Error	Unsuccessful in sending four word message to SPC-16. Job is terminated.
Up Link Error	Unsuccessful in completing a 328 data word transfer from SPC-16 to the 370. Job is terminated.
EWO DATA ID NO. = 763650800	Experiment Identification Number.
WAITING FOR MISSION START	Program is waiting for experiment monitor to turn experiment control switch to "RUN" position.
FORCED ENDING ON DI	Warning message. Program was forced to complete channel ending during an execute channel on digital inputs.

TABLE 4: MESSAGES AND CODES

Console Typewriter Messages	Explanation
FORCED ENDING ON DO	Warning message. Program was forced to complete channel ending during an execute channel on digital outputs.
SPC-16 UNABLE TO RE-START. WITH TRY TO RECOVER	This message informs the computer operator that a restart is necessary. The operator should follow the procedures outlined in APPENDIX II under Error Recovery Procedures. (Instruction Set 1)
RESET MISSION START/ STOP SWITCH TO FREEZE	Computer operator must inform experiment monitor to turn experiment control switch from "RUN" position to "FREEZE" position.
SPC-16 RECOVERY REPLY 'GO' or 'NO'	After the SPC-16 has been restarted and the experiment monitor assures himself and the operator that everything is ready, the operator must type in: r oo, 'GO'.*
SPC-16 READY. REPLY 'GO' or 'NO'	This message informs the operator that everything is okay. When communication between the operator and experiment monitor are in a ready status the operator types in: r oo, 'GO'.*
T4EXEC -- Step1 ABEND Uo555	Program termination due to unrecoverable forced ending of DO or DI. NOTE: follow recovery procedures outlined in APPENDIX III.

* If the operator types in 'NO' the program automatically terminates.

TABLE 4: MESSAGES AND CODES (Concluded)

APPENDIX IV

SPC-16 DOWNLOAD PROGRAM

T e Download Program was written to download an output data set from a cross assembler program to the SPC-16 computer through the 1827 Data Control Unit. This data set is actually a dump data set which is output to disk by the SPC-16 simulator which runs on the S/370. A byte count via an input control card is used. Example: If the user wants to download a cross assembler output data set to the SPC-16 at a starting memory location of hexadecimal 1000, the control card would contain a decimal value of 4096. The program is terminated when an end of file is reached on the download input file.

Figure 22 illustrates the format of the SPC-16 Download Control Card Input. The Download Execution Deck is shown in Figure 23. The Flow-chart of the SPC-16 Download Program is presented in Figure 24. The operating instructions are contained in the User's Guide, Appendix IV.

RECORD NUMBER	RECORD POSITION	CONTENTS	FORTRAN FORMAT	UNITS
1	1-5	Number of bytes in hexadecimal to pass on input data set before downloading information to SPC-16	I5	-
	6-80	UNUSED		

FIGURE 22. SPC-16 DOWNLOAD CONTROL CARD INPUT

```
//DNLDEXEC  JOB
//STEP1     EXEC  PGM=DOWNLOAD
//STEPL1B   DD    DSN=IBM.EXEC,DISP=SHR
//INCARD    DD    DDNAME-SYSIN
//DNLOAD    DD    DSN=SPEC16.LOADMODS(T4SIM),UNIT=3330,DISP=OLD,
//                DCB-(RECFM=VSB,BLKSIZE=4484,LRECL=112,VOL=SER=PUBLIC
//DDOUT     DD    UNIT=005
//SYSUDUMP  DD    SYSOUT=A
//SYSIN     DD    *

  CONTROL CARD GOES HERE

/*
```

FIGURE 23. DOWNLOAD EXECUTION DECK

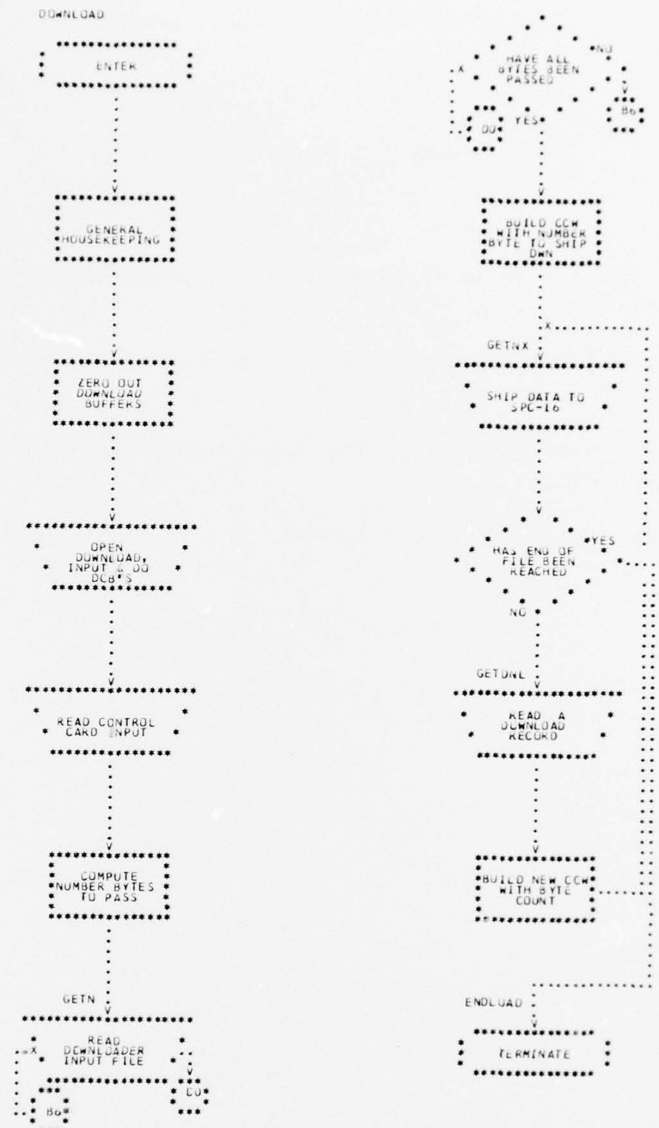

FIGURE 24. SPC-16 FLOW DIAGRAM

USER'S GUIDE

The following steps may be used as a guide for using the SPC-16 Download Program:

1. Prepare the input control card according to the format defined in Figure 22.
2. Place the control card in the execution deck illustrated in Figure 23.
3. Load the execution deck into the card reader and ready it.
4. Mount the requested disk packs.
5. At the completion of the run, remove the cards from the card reader and the listing from the printer.

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